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FROM

EXPERIMENT STATIONS

SEASON 1952-53

TANGANYIKA TERRITORY
EASTERN PROVINCE

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TANGANYIKA TERRITORY
EASTERN PROVINCE

PROGRESS REPORT FOR THE SEASON 1953

BY

E. W. VALENTINE.

Introduction.

Weather and Growing Conditions.—The rains between uprooting in November and planting in March (which totalled only 11·74 inches compared with an average over 8 years of 26·99 inches) and a long dry spell of five weeks before the March rains began, contributed to rather unsatisfactory planting conditions. Maize planted after a heavy shower in early February fortunately survived through this dry weather. The first plantings of cotton were made on 18th March and the whole area was completed by 26th. Rainfall during April and May, distributed over 43 days, was above average; this led to rapid weed growth, necessitating early hand weeding to prevent excessive smothering of young seedlings. From June till the end of the season just over 3 inches were recorded in the cotton area. Much of this fell during October as light misty rain, which held up picking for days at a time. As shown in Table 1, the rainfall for the whole year was 8·8 inches less than the average over 8 years.

Table 1.

Rainfall at Ilonga (inches).

	1952-53.	*8 year average.*	
November	1·88	3·85	
December	0·49	5·79	
January	2·58	6·54	
February	2·11	3·77	
March	4·68	7·04	Cotton planting.
April	8·95	8·19	
May	8·25	2·69	
June	0·28	0·21	
July	0·49	0·51	
August	0·88	0·43	
September	0·39	0·49	Cotton picking.
October	1·25	1·53	
Total	32·23 inches.	41·04 inches.	

Cotton Breeding.

96 strains of single plant selections made in 1951 were grown, and further selections were made. From the point of view of yield, some of these appear to be promising, having given the equivalent of over 1,000 lb. seed cotton per acre.

23 special bulks of pre-1949 selections were planted. The yield results from these are not reliable, as it was found, first by observation, and afterwards by picking, that the plots to windward were not as effectively protected by insecticides as those to the leeward side of the fields. There was a definite "insecticide gradient" in all three fields used.

The rest of the cotton area, consisting of $7\frac{1}{2}$ acres for the insecticide trial, and $108\frac{1}{2}$ acres of bulk cotton for seed, was planted with 47/10.

Seven district plots in different areas of the Eastern Province were planted with 47/10 and Local strains. In addition to the bulks grown on Ilonga, approximately 280 acres of 47/10 were grown in two areas of the Kilosa District, and 220 acres in the Dutumi area of Morogoro District. The yields from these plots are given in Table 2.

TABLE 2.

SUMMARY OF YIELDS FROM DISTRICT PLOTS AND BULKING PLOTS.
LB. SEED COTTON PER ACRE.

District.	*Acreage.*	*47/10.*	*Local.*	*Difference 47/10– Local.*
Mvomero	5	373	458	– 85
Mkundi	5	699	311	+388
Dakawa	5	444	308	+136
Kisaki	5	404	318	+ 86
Malolo	1	192*	170	+ 22
Melela	1	322	294	+ 28
Mwaya	1	210	154	+ 56
Ilonga	116	260		
Kilosa bulks	160	235		
	120	not known		
Dutumi bulks	220	406		

*Extreme drought.

The yields from the Kilosa District were disappointingly low, partly because the good rains of April and May led to the extensive formation of surface roots, which proved inadequate for the dry conditions which followed, and partly because of heavy insect attack. Insect populations recorded in the district plots were never as high as those on Ilonga.

Insecticides were applied in the Kilosa bulking fields, but really effective control was not achieved, as the area was too large for treatments to be given as frequently and regularly as was desirable, with the machinery available. High winds during June cut down the effective working time, and it is considered that much of the insecticide must have been blown from the plants after the application was made. Control was much more efficient in the insecticide trial where the plots were sheltered from wind by tall sorghum barriers.

Insect Pests.

American Bollworm (*Heliothis armigera*).

Field Sampling.—Samples were taken in known host crops in the vicinity of Ilonga between the 1952 and 1953 seasons. Twenty native maize crops were examined between September and February, at weekly intervals while they were in flower. The first bollworm was found in early January on October planted maize, and from then on the populations increased during January and February on November planted maize. Further plantings were made in the first week of February, but except on Ilonga itself, most of this failed owing to a combination of lack of rain and armyworm attack during the following six weeks. The next plantings were in mid March, and a high population built up on these in May.

During the same period some larvae were recorded on groundnuts, pigeon pea (*Cajanus indicus*), and tomato, but in no case did the population reach the high level found on maize. Evidence of damage was first seen in cotton in late April, and by the beginning of May the flared squares count had reached the equivalent of 1,000 per acre, the point which was taken for the start of insecticide applications . The recorded larval population at the same time was only slightly less than 1,000 per acre. A routine weekly (10%) count made in untreated cotton showed that the population at the end of May had increased to 2,000 larvae per acre; this rose very rapidly to a peak of 13,000 on 18th June, after which it decreased to approximately 750 in mid July. By the end of the month none could be found. This followed the general pattern of attack in previous years, but the numbers fell away more quickly.

High populations of *Heliothis* were also found during the cotton season in chick pea (*Cicer arietinum*) and in short sorghums, particularly those varieties with compact heads. These crops seem to be more attractive to bollworm than cotton, as in both cases the estimate of population was much higher. However, as the peak populations occurred in late June and early July, about a fortnight later than in cotton, it does not seem likely that many of these could reinfect cotton. On the other hand, the peak populations in maize occurred in late May and early June, so that adults from the earlier pupations from this crop could come into cotton during June, and those from later pupations into chick pea and sorghum, in late June and July.

It is probable that the population of bollworm is correlated with the proximity of maize; at least there was an indication of this, as those fields at a greater distance from maize plots tended to give a higher yield. A few specimens were also collected from loofah and castor oil plants and beans.

Pupation Periods.—Further investigations were carried out in the measurement of pupation periods. Sixth instar larvae were allowed to

pupate in tins of dry soil at air temperature. The average length of the pupation period increased in the first seven months of the year, when pupae were available, in the following way:—January—12 days; February—14; March—15; April—15; May—17; June—23; July—25. This seems to be more directly correlated with mean minimum temperatures than with any other factor studied. A small proportion of long term pupae were formed during June and July, some of which did not emerge until after 80 days. In previous years pupation periods of up to 127 days have been recorded. Next season more intensive recording of pupation periods under field conditions will be continued in an attempt to determine the factors responsible for the increase in length during the season, and the formation of long term pupae.

Pink Bollworm (*Platyedra gossypiella*).

As in previous years the pink bollworm population was small, and was not recorded until September when the flowers of the top crop began to open in untreated plots. A small number were found in the treated plots of the insecticide trial in mid September, but by this time the bolls had opened.

Spiny Bollworm (*Earias spp.*).

In untreated cotton the population remained at a low level from the time of first recording in late May until mid July, when it rose above 1,000 per acre, reaching a peak of almost 2,000 per acre later in the month. It then declined rapidly, being negligible by August. The situation was different in the insecticide treated plots, where the population was over 1,000 per acre in early June and that in the control plots reached a peak of 6,700 per acre at the same time. This was probably due to the close proximity of freely flowering cotton. There was an increase in recorded numbers in treated plots during July. This was due to the cessation of insecticide applications, and the decrease of American bollworm.

Stainers (*Dysdercus spp.*).

The biggest populations of stainers were those of *D. intermedius,* which came into the crop at the end of May. This species remained until the end of the season, reaching a peak population of 4,000 adults and mating pairs in early July, when nymphs began to make their appearance. *D. fasciatus,* which was present in small numbers for most of the season, increased slightly during August, but did not come to its peak of 1,200 till October. Extensive breeding did not take place until September. *D. nigrofasciatus* and *D. cardinalis* were also recorded in variable numbers. The approximate proportions of the four species were as follows:—*D. intermedius,* 77%; *D. nigrofasciatus,* 7%; *D. fasciatus,* 15%; and *D. cardinalis,* 1%.

It can be shown from this year's records that the numbers of stainers in cotton are directly related to the rate of flowering. Numbers of all species were higher during the maximum flowering period, June and July, and in the sudden flush of flowering in September and October.

Lygus vosseleri and Empoasca spp.

Both of these insects were present in the crop, and some evidence of damage was noted but was not considered to be significant. Higher populations were found on beans.

Prodenia litura.

This was found to be responsible for most of the leaf feeding and some boll damage early in the season and was effectively controlled by insecticides. In untreated plots it caused a considerable amount of leaf damage, but where the bollworm attack had been high it was not distinguishable from leaf feeding by bollworms themselves.

Oxycarenus hyalinipennis.

Adults of this species were seen on cotton in June, before any bolls had begun to open, and were found to be breeding in the drying seed heads of an Abutilon (*zanzibaricum*?) during that month and July. When the cotton bolls were opening the population built up and breeding began to take place. The level of infestation was very variable from place to place, and at times extended over only a very small area. In order to remove these insects, the seed cotton was laid out in the sun and covered with hessian or other coarsely woven material. The insects crawled from the cotton through and on to the top of the hessian.

Calidea dregii.

Only three adults and one batch of eggs were found during the season.

Helopeltis bergrothii.

None was found, either in cotton or on other host plants.

Some losses occurred in May, due to damage to the base of the main stem the exact cause of which was not determined. At the time of examination the plants had already been attacked by termites but many had small holes at ground level. It is considered that the primary damage was caused by a stem boring weevil, and that termites attacked the plants later. An estimate of damage was made in conjunction with a stand count, over an area of six acres, by counting those plants which had fallen or which showed excessive wilting and stem damage. This amounted to almost 1%.

Insecticide Trial.

This was laid out in fifteen randomized blocks of five plots, each of $\frac{1}{10}$ acre, using the standard 10% DDT 3% BHC dust with the object of finding a more efficient and economical treatment. The dust was applied at rates of 8 and 16 lb. an acre per application at intervals of 7 to 10 days, so that the estimated period of effective cover in each case would total approximately 50 days. Tall sorghum barriers six yards wide were grown between the plots.

FIG. 1
ANALYSIS OF CROPPING

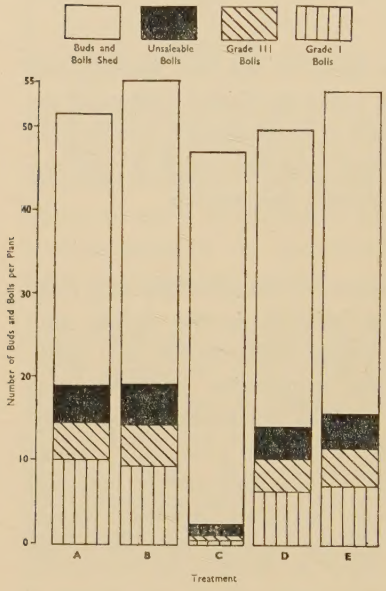

FIG. 2
COMPOSITIONS OF BOLLWORM POPULATIONS

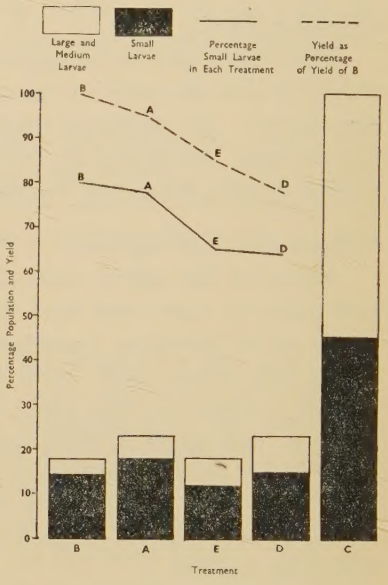

FIG. 3
BOLLWORM POPULATIONS

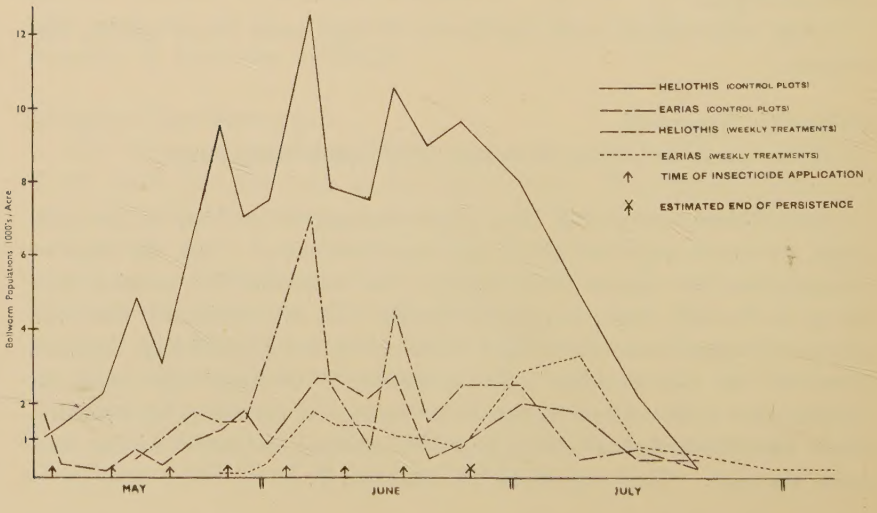

TABLE 3.

RESULTS OF INSECTICIDE TRIAL.

Treatment.	*Rate per application.*	*Interval in days.*	*No. of applications.*	*Total weight.*	*Yield lb. per acre.*
A	8 lb.	7	7	56	835·47
B	16 lb.	7	7	112	879·25
Control	0 lb.	—	—	—	46·23
D	8 lb.	10	5	40	687·72
E	16 lb.	10	5	80	750·84

Difference between AB : DE significant at P = ·001. All treatments significantly better than control.

The first applications were made on 6th May, when the flared square count reached the equivalent of 1,000 per acre.

Records were kept of the fate of buds by ticketing them when they were large enough. The dates and causes of shedding were noted, and an analysis by locs of damage to bolls was carried out. Records of shedding given in Table 4 are those due to all causes. Bollworm accounted for a high proportion of these, but in many cases the exact cause was indeterminable. Sheds attributed to stainers were negligible, while those due to other causes amounted to 3-4% of the total number of buds formed in each treatment, except in control plots where bollworms were responsible for a greater proportional loss of buds and bolls. The total number of buds recorded on the control plots is less than that of other treatments, as some loss occurred before they were large enough to be ticketed. Compared with last year the number of buds recorded in equivalent treatments was approximately 20% lower this season.

As they opened, bolls were graded by locs for damage by bollworm and stainers. Grade 3 cotton due to staining by stainers amounted to 6-7% of the total saleable cotton, in each treatment. Other discolouration was attributed to bollworm damage, and secondary infection by bacteria and fungi.

TABLE 4.

ANALYSIS OF CROPPING RECORDS.

All figures are of numbers of buds or bolls per plant.
(100 plant sample per treatment.)

Rate lb. per acre.	*Freq. days.*	*Buds recorded.*	*Lost by shedding*	*Retained on plant.*	*Number harvested.*	*Number Grade I.*	*Percentage harvested.*
8	7	51·78	32·68	19·10	14·64	10·09	28·27
16	7	55·60	36·37	19·23	14·49	9·48	26·15
8	10	49·92	35·76	14·16	10·36	6·48	20·75
16	10	54·49	38·68	15·81	11·68	7·18	21·44
Control	—	47·31	44·83	2·48	·90	·40	1·91

Assuming that cultivation and other management costs etc. were the same, a costing was made on the basis of cost of insecticide and of its application only. There would be a difference in picking and grading costs according to the weight and quality of the crop, but these are difficult to estimate, so that the profits shown in Table 5 are only relative.

TABLE 5.

TOTAL YIELD AND VALUE OF CROP.
(In order of net profit.)

Rate lb. per acre.	*Freq. days.*	*Yield lb./acre.*	*Grade % No. I.*	*Value No. I.*	*Value No. III.*	*Value Total.*	*Cost*	*Value less Cost*
8	7	835	75·17	299/25	35/32	334/57	76/30	258/27
16	7	879	75·52	331/28	32/26	363/54	149/10	214/44
8	10	687	67·23	230/68	33/73	264/41	54/50	209/91
16	10	750	68·85	257/99	35/02	293/01	106/50	186/51
Control	—	46	47·26	10/90	3/65	14/55	—	14/55

Value of seed cotton No. I: 50 cents per lb.; No. III: 15 cents per lb.
Costs: The cost of insecticide and labour for application only.

Yields from weekly applications were significantly greater than those of ten days, but there was no significant difference between different rates of application at either 7 or 10 day intervals. All treatments gave a significantly higher yield than controls. The most economical treatment was one of low rate of application at weekly intervals.

Insect Recording in the Insecticide Trial.

Counts of bollworm eggs, bollworms, and stainers were made in the trial (1% sample) on the day before and three days after application of insecticide.

Egg Counts.—These indicated that there were four "flushes" of egg laying between early May and late June. Fluctuations in bollworm populations followed these egg layings. It is probable that these were laid by successive influxes of adults from other crops, but it is possible that adults from mid May pupations could have laid in the crop in early June, when the egg count was at a peak. Counts in the seven day application plots were relatively higher, which might be accounted for by the fact that the plants flowering more freely and carrying a bigger crop were more attractive.

Bollworm Counts.—Insecticides were effective in as much as the bollworm population was reduced to 17-23% of that in control plots. All larvae collected were graded according to size into the following groups:—Large (5th and 6th instar larvae), Medium (late 3rd and 4th),

Small (1st to early 3rd). It was found that the final yield from any one treatment was correlated with the composition of the population. Complete records were kept from the time of the first insecticide application until no more larvae could be found in the crop. An analysis of these records showed that where insecticides were applied at seven day intervals the proportion of small larvae in the population was much higher than where treatments were made at ten day intervals. This indicates that more larvae were being killed before they reached the stage when they could be classified as medium or large, that is before reaching the fourth instar. The same effect was produced by increasing the rate of application of insecticide. In Table 6 the total population in each of the treatments is expressed as a percentage of the total population in control plots. It will be seen that the total populations of bollworm in plots treated at seven and ten day intervals are very little different when the same weight of insecticide is applied, but that the proportion of medium-large larvae is greater when the intervals are longer, and that the yield is correspondingly lower.

TABLE 6.

COMPOSITION OF AMERICAN BOLLWORM POPULATIONS IN THE INSECTICIDE TRIAL, 1953.

Total populations in each treatment from 6th May to 22nd July 1953. Larvae as a percentage of total population in control sample. Totals for D & E weighted to the same frequency and number of applications as A, B, & C.

Treatment.	*Total population.*	*Percentage small larvae.*	*Yield lb./acre.*	*Yield percentage of B.*
B.16 lb.× 7 days	17·74	80·2	879	100·0
A. 8 lb.× 7 days	23·06	77·9	835	95·0
E.16 lb.×10 days	18·40	65·1	750	85·4
D. 8 lb.×10 days	23·31	64·6	687	78·2
C. Control	100·00	45·3	46	5·3

Stainers.—There were no significant differences in the populations of stainers between treatments, but it was very noticeable, as would be expected, that the rate of breeding was much greater in those plots which had been protected from bollworm.

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